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Tower Systems, Inc.

INSTRUCTION MANUAL

TOWER INSTRUMENTATION ELEVATOR SYSTEM

MODEL TS-3000

ELEVATOR IDENTIFICATION NUMBER

00-94433

WARNINGS AND DISCLAIMERS

The elevator systems described herein was not designed or intended for any type of human support or transport. Tower Systems, Inc. hereby disclaims any liability or responsibility whatsoever for any injuries or damages resulting from such improper use or from any other improper use, or failure to follow the instructions provided with the system, or from lack of proper maintenance of the system.

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1.3.2 DRIVE AND MESSENGER CABLE

- Diameter	0.375 in.
- Stainless steel cable	type 7 x 19

1.3.3 RAILS

- Diameter	1.25 in.
- Wall thickness	0.083 in.
- Material	304 - Stainless Steel
- Distance between mounting brackets	30.0 in. Maximum

1.3.4 CARRIAGE

- Width	21.15 in.
- Height	48.0 in.
- Support rollers	18 each

1.3.5 INSTRUMENT BOOM

- Length	N/A
- Supports	N/A
- Material, aluminum pipe, schedule 40	N/A

1.4 WARRANTY

Tower Systems, Inc. warrants that each item, of its manufacture only, to be free from defects of material and workmanship. Any faulty part or parts will be repaired or replaced at the sole discretion of Tower Systems only after being returned to Tower Systems for inspection within one year from date of shipment to the original purchaser. Transportation charges for warranty repairs shall be paid by the customer.

This warranty shall be null and void if it is determined by Tower Systems, Inc. that the item or items have been subject to misuse, accident, neglect, or improper application; or that the item or items have been repaired or altered by other than Tower Systems' personnel.

This warranty is in lieu of all other warranties expressed or implied. Tower Systems, Inc. shall not be liable for collateral of consequential damages.

1.5 SAFETY PRECAUTIONS

The Model TS-3000 Tower Instrumentation Elevator System is a electro-mechanical system with moving parts. Care must be taken to stay clear of all moving parts, such as cables, carriages, winch, etc.

Care must also be taken to avoid electrical shock when working on the wiring system. Voltages are present that are capable of causing death.

WARNING: Do not use this elevator for human support or transport.

2 INSTALLATION

2.1 UNPACKING AND INSPECTION

Carefully unpack the system. Inspect the systems visually for damage which may have occurred in shipping. Immediately notify the shipper and the factory of any shipping damage.

2.2 INSTALLATION

It is recommended that the system installation be accomplished in the sequence established in the following steps.

2.2.1 BOTTOM SHEAVE ASSEMBLY

1. Establish the exact location that the bottom sheave assembly is to be installed on the tower. (Note: This is generally the lowest point on the tower that the assembly will fit.)
2. Place the bottom sheave assembly on the tower so that the tensioning bolt is pointing straight up an the angles are just below a set of horizontal braces on the tower. (Note: The front sheave is offset so it will be in line with the winch cable.)
3. Install a U-bolt around each of two tower legs and through the top set of holes in the cross brace.
4. Install the four U-bolts on the third leg.
5. Tighten the front U-bolts and the bolts on the third leg.

2.2.2 WINCH ASSEMBLY

1. Remove the winch cover.
2. Place the winch assembly against the face of the tower just above the bottom sheave assembly cross brace.
3. Make sure that all of the bolts and nuts on the back of the winch assembly are clear of any tower braces.
4. Make sure that the spring tensioned sheave bolt has clearance to protrude from the back of the winch assembly by at least 4 inches.
5. Install the eight U-bolts around the tower legs.

6. Make sure that the winch assembly is mounted square on the tower.
7. Tighten the U-bolts.

2.2.3 RAILS

1. Make up 32 inches from the top of the winch assembly. Mark that location on the tower.
2. Place a rail bracket on the face of the tower centered on the mark. Make sure that the flat of the angle is up.
3. Install a U-bolt around each of the two tower legs and through the rail bracket.
4. Make sure the rail bracket is level.
5. Tighten the U-bolts.
6. Place a 30 inch rail section over each of the two coupling tubes on the rail bracket. Make sure that the slotted end is down and that the slot fits around the standoff.
7. Place another rail bracket on top of the two rail sections. Make sure that the flat side of the angle is up.
8. Install the two U-bolts and tighten.
9. Install two 30 inch rail sections on the last bracket installed. Make sure slotted end is down and that the slot fits around the standoff.
10. Repeat steps 7, 8 and 9 until rails have been installed up to the point that is designated as an instrument level. Make sure that the brackets are installed level and that the rails are all straight. If interference is encountered from the tower braces, cut off two rails the same amount to relocate the bracket. Be sure that you cut off the unslotted end.
11. Each time an instrument level is reached the rails should be centered on the carriage.
12. Continue to install rails until the desired height has been reached.
13. Install the two ice caps on the top rail bracket.

2.2.4 TOP SHEAVE ASSEMBLY

Place the top sheave assembly on the tower above the top of the rails. It is installed the same as the bottom sheave assembly except it is inverted and is mounted above the horizontal braces on the tower.

2.2.5 DRIVE CABLE

1. Thread through the top sheave assembly, bottom sheave assembly, all cable guides, and the winch assembly. (Ref. drawing A10131) Splice must be above winch assembly as shown.
2. Place a haven grip on each end of the cable approximately six feet apart.
3. Connect a one ton cable-pull between the two haven grips.
4. Take up tension on the cable pull until the spring on the spring loaded sheave assembly is fully compresses. (Note: Be sure that the adjustment sheave is in the full down position.)
5. Be sure that all cable ends, haven grips and the cable-pull are clear and will not hang up.
6. Place the up-down switch in the up position. Depress the on-off switch. Let the cable travel up 4 to 8 feet.
7. Stop the winch. Reverse direction and let it run back down. Stop the winch.
8. Take up any additional tension that is required on the cable-pull.
9. Repeat steps 5 through 8 until all cable slack has been taken out of the double-drum winch and cable is stretched into place.
10. Cut the excess cable ends off leaving one inch of overlap. Make sure that the cables are cut straight and clean.
11. Install the cable splice as follows:
    - When installing the splice it is recommended that a Tower Systems Assembly Kit be used to prevent the cable from being nicked, to protect the lay of the cable, and to hold all of the wires in the strand firmly so that the plug can be driven to a solid seat.
    - Clamp the assembly block on the cable.
    - Position the assembly block so that the 3 inches, + 1/8 inch, -0 inch protrudes from the block. Tighten the assembly block firmly.
    - Remove seizing from the end of the cable.

- Twist the unthreaded end of the sleeve over the end of the cable. Twist in the direction of the lay of the cable. With the sleeve all the way against the block, check to be sure that 1.125 inch, +1/8 inch, -0 inch of cable protrudes beyond the sleeve.
- Unlay one of the six outer strands, if cable has a right hand lay, unlay each of the other five strands in counter-clockwise order. If cable has a left hand lay, unlay each of the other five strands in clockwise order. When done correctly, the six outer strands form a symmetrical basket. Do not attempt to straighten the spiral lay of the six strands.
- Do not unlay the wire in the center strand. Insert the hollow plug over the center core. The symmetrical basket shape should be retained while the plug is being seated. Drive the plug to a solid seat.
- With a piece of tubing, bend each of the six outer strands toward the center of the plug. Tubing is furnished in the assembly kit.
- Place a socket over the ends of the strands and twist it on in the direction of the lay of the cable. Engage threads of sleeve and tighten socket securely on the sleeve. (Note: Tighten both sides the same amount at the same time.)
- If assembled correctly the end of the cable will be visible in the inspection hole. Several threads will be visible on the sleeve after tightening.
- When the cable is pretensioned, the plug will seat further in the sleeve and the cable may not be visible in the inspection hole. The final seating of the plug insures an assembly of maximum strength.

12. Run the winch in both directions several times. Check the compression of the spring on the spring loaded sheave. It should be compressed within one inch of being fully compressed. If it is not, adjust the manual tensioning sheave until it is.

2.2.6 CARRIAGES

1. Place the top carriage assembly on the rails.
2. Position the cable splice so it is just below the top plate on the top carriage assembly.
3. Clamp the carriage to the cable with four 3/8" cable clamps.
4. Raise the top carriage until the second carriage can be installed at the correct elevation. Stop the elevator as required to attach the electrical cables to the drive cable.

5. Raise these carriages until the third can be installed if required. Repeat for the fourth if there is one.
6. Paint the cable clamps and cable on all the carriages and mark their position on the cable.

2.2.7 MESSENGER CABLE

1. Connect the messenger cable to the bottom plate on the top carriage using two cable clamps.
2. Run the top carriage up to its operating position.
3. Secure the messenger cable to the bottom rail bracket. (Make sure that the cable is taught.)
4. Secure the electrical cables to the messenger cable with tie-wraps about two feet apart.

2.2.8 ICE CHIPPERS (Optional)

1. Eight ice chippers are required for each carriage.
2. Place one ice chipper just inside each end of each channel on the carriage.
3. Install two 1/4- 20 x 3/4" bolts on each ice chipper and tighten securely.

2.2.9 INSTRUMENT BOOMS

1. Select the longest boom member and install the four-hole flange on the end that has a hole drilled through one side approximately 1" from the end.
2. Fasten the above boom member to the carriage with 1/4 inch flat head bolts in the four holes provided at the top center of the carriage.
3. Select the shortest boom member and install a three hole adjustable flange at one end and an adjustable tee at the other end.
4. Slide the adjustable tee over the main boom member and fasten the adjustable flange on the lower right corner of the carriage in the three holes provided. Use 1/4 inch flat head bolts.
5. Select the remaining boom member and install a three hole adjustable flange at one end and an adjustable tee at the other end.
6. Slide the adjustable tee over the main boom member and fasten the adjustable flange on the lower left corner of the carriage in the three holes provided. Use 1/4 inch flat head bolts.

7. Install the cross on the end of the boom main member with the set screws provided.
8. Install the instrument mount and instruments on the cross.
9. Level the boom main member and insure that it is perpendicular to the tower face. Tighten all set screws on the adjustable tees to insure that the boom remains level and square.

3 PRINCIPLES OF OPERATION

3.1 SYSTEM CONCEPT

The TIES is designed to provide two different types of functions: The first to allow instrumentation that is permanently mounted on a tower to be brought down to ground level for servicing without the necessity of climbing the tower. The second is to provide a means of transporting an instrument package up and down a tower, while the instrument is operating, to obtain a vertical profile of the parameters being monitored.

The instrumentation that is to be mounted on a tower at a fixed level may be of several different types:

- a meteorological monitoring station consisting of wind speed, wind direction, temperature, etc.,
- a gas analyzer such as NOx monitor, or
- a high volume sampler for particulate measurements.

For gathering vertical profile data the following methods may be employed:

- a small transmitter can be attached to the instrument package to transmit the data to a ground base receiver,
- a cable can be towed along to carry the data to the ground, or
- a recorder can be carried along with the instrument package, allowing the data to be retrieved when the instrumentation is returned to the ground.

The design of the systems is such that with the appropriate options any of the above types of functions can be accomplished.

3.2 DRIVE UNIT

The heart of the drive unit is a custom designed reversible, dual-drum winch. This winch drives an endless loop that is used to power the carriages. With this technique the carriages are safely and smoothly powered up and down without the nuisance of two winches or a lot of loose uncoiled cable.

The endless cable loop runs from the winch over a spring tensioned pulley. This device always maintains tension on the cable, eliminating any problems from cable stretch or thermal contraction or expansion.

The cable then runs over an idler pulley and up the face of the tower to a pair of pulleys at the top. After going over these two pulleys it comes down inside the tower to the bottom to a group of three pulleys. Two of the three pulleys are idlers and the third is used as a manual tensioning device. This tensioning device permits the operator to adjust the tension from the base of the tower no matter where the carriages are located. The cable then runs over one more idler pulley and back to the winch.

The winch drives the cable at approximately 20 feet per minute providing a smooth ascent or descent for the instruments.

The winch drive motor has a special electrical braking circuit incorporated into it preventing the carriages from travelling more than one half inch after the winch is turned off.

The drive unit is designed so that limit switches can be incorporated to automatically stop the carriages at the desired position.

Additional control circuitry and switches can be incorporated to have the systems automatically sequence at predetermined times such as, cycle to the top and back down at given intervals for vertical profile studies.

3.3 GUIDE RAILS

The guide rails on which the carriages travel consist of two 1 1/4 inch diameter tubular stainless steel rails spaced 16 3/4 inches apart.

The spacing between the rails was selected to provide a horizontal stability such that any normally mounted sensor will not experience any angular deviations of more than 1.0 degree, even with winds up to 80 miles per hour.

The rails are secured to the tower by brackets that are designed for the specific tower being used.

3.4 INSTRUMENT CARRIAGES

The carriage assemblies are designed so they ride on eighteen rollers. There is one set of three rollers at each corner of the carriage. This design provides the maximum stability in both the horizontal and vertical direction.

The carriages can also accommodate the necessary mounting hardware for instrument packages that do not require booms. A maximum weight of 270 lbs. can be carried on each carriage assembly. [up to 1,700 lbs. total weight]

The carriages are secured to the drive cable with four easily removable clamps to allow the operator to easily remove each carriage from the

tower as it comes down. As each carriage is removed the carriages above it can be brought down and removed in sequential order. To replace the carriages the reverse procedure is followed. The drive cable is clearly marked so the operator can replace each carriage at it's proper position on the drive cable.

4 OPERATING INSTRUCTIONS

4.1 OPERATING CONTROLS

On-Off	Enables the operator to start and stop the drive unit.
Up-Down	Enables the operator to select the direction of the drive unit.

4.2 OPERATION

These operating instructions assume that the system is completely installed and all carriages are on the tower in their normal operating position.

4.2.1 LOWERING THE CARRIAGES

1. Make sure that there are no obstructions to any moving parts.
2. Place the up-down switch to the down position.
3. Depress the on-off switch.
4. Coil the messenger cable and electrical cables as they come down.
5. When the bottom instrument carriage reaches the bottom of the rails release the on-off switch.
6. Remove the two clamps that attach the carriage to the cable.
7. Remove the carriage from the rails.
8. Depress the on-off switch.
9. Coil the messenger cable and electrical cables as they come down.
10. When the next carriage reaches the bottom of the rails release the on-off switch.
11. Repeat steps 6 through 10 until all carriages are lowered to the bottom of the tower.

4.2.2 RAISING THE CARRIAGES

1. Place the top carriage on the rails and line up the cable clamps with the marks on the cable.
2. Install cable clamps and tighten.
3. Make sure that there are no obstructions to any moving parts.
4. Place the up-down switch to the up position.
5. Depress the on-off switch.
6. Feed the messenger cable and the electrical cables up the tower as the carriages go up.
7. Advance the carriages until the color coded spot on the drive cable is in position for installing the next carriage.
8. Place the next carriage on the rails and line up the cable clamps with the marks on the cable.
9. Install the cable clamps and tighten.
10. Repeat steps 4 through 9 until all carriages are installed.
11. Depress the on-off switch.
12. Feed the messenger cable and the electrical cables up the tower as the carriages go up.
13. All the drive unit to run until the carriages are in their normal operating position.
14. The system is now ready for the instrumentation to be put back into operation.

5 MAINTENANCE

5.1 MAINTENANCE

The following inspection should be conducted every six months to assure that the Tower Instrumentation Elevator System will continue to operate properly and provide optimum service.

- Visually inspect the drive cable for broken strands or excessive wear. Give special attention to the cable splice, make sure it is tight and that the cable is properly seated.
- Inspect all of the sheaves for wear. Check to see that all retaining pins are in place and on the shafts and that the pins are in good shape.
- Verify that the spring on the spring loaded sheave is compressed about half way. If it is not, adjust the cable per paragraph 5.2.
- Inspect the winch for loose bolts, oil leakage, excessive wear, etc.
- **LUBRICATION:** It is extremely important that the proper oil level in the gear case is maintained. Failure to do so will result in gear and/or motor failure.

  Check the oil level in the winch gear box. (This should be done when the winch has been run and the gear box is warm. It is possible to overfill the gear box if filled when it is cold. An overfull gear box will cause the motor to overheat, resulting in motor failure. **CAUTION**: Never check the gear case lubricant level or fill with oil while the winch motor is running. The oil should be within 1/4 inch of the access hold. If it is not, oil should be added. Winches shipped after 1/1/79 have gear case lubricant designed for cold weather operation. They are provided with Mobilube SHC synthetic lubricant with a pour point of -75 degrees F. Amzoil Synthetic Gear Lube SAE 80W -90 is an acceptable replacement. This gear lube will provide protection at gear case operating temperatures of -55 degrees F to +195 degrees F. However, gear case temperatures in excess of +195 degrees F may be encountered in warm weather conditions. For warm weather conditions use Mobilgear 632 Lubricating Oil or an equivalent synthetic gear case oil.

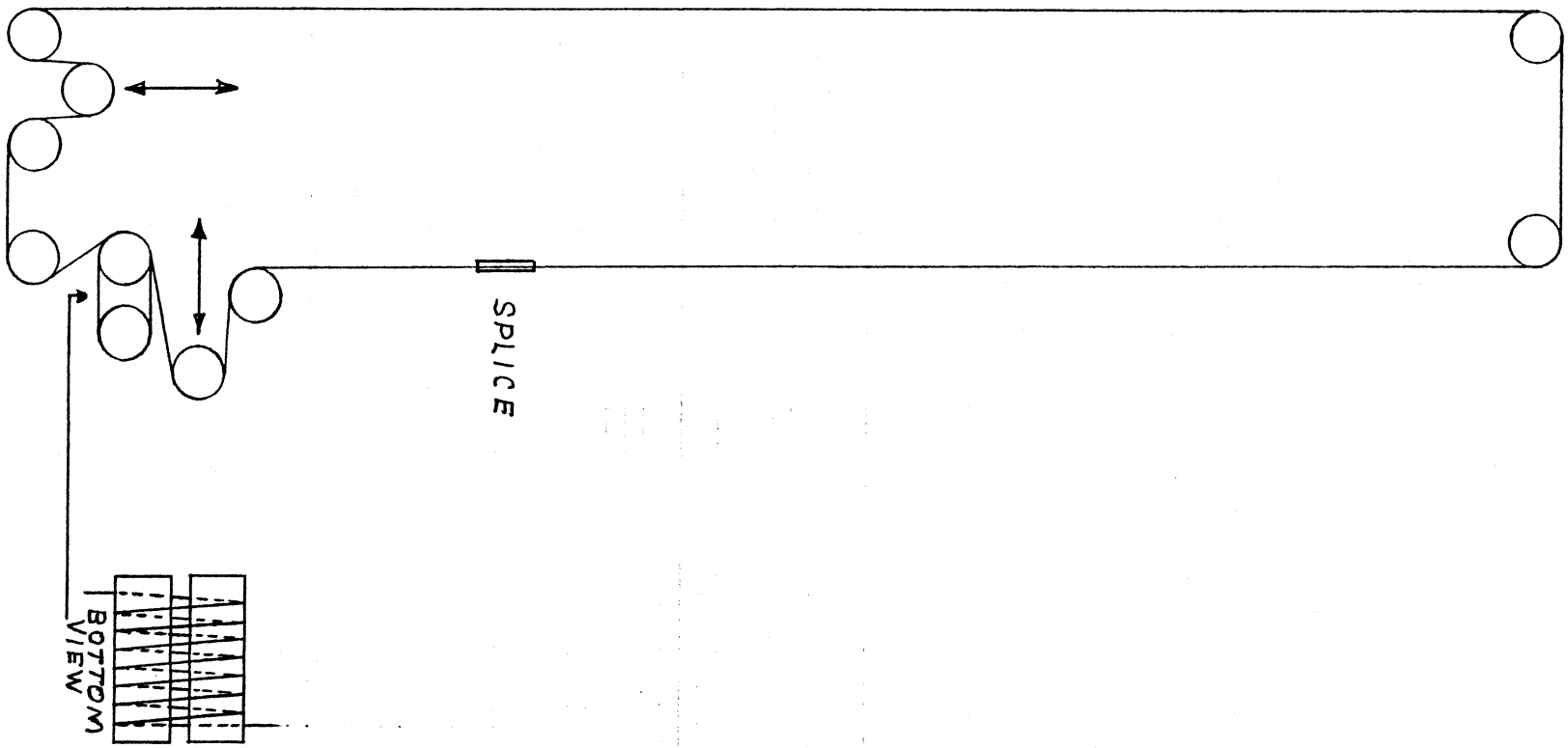
  CAUTION: Gear case oil must be nondetergent non-foaming oil. Avoid all lubricants, such as EP, that are not compatible with bronze gears. NOTE: No other lubricants than those described above are necessary- all outside bearings, etc. are prelubricated and sealed.

- Inspect the rails and rail brackets for loose bolts, excessive wear, physical damage, misalignment, etc.
- Inspect the carriages and instrument booms for excessive wear, physical damage, loose bolts, etc.
- Check the control box for contamination, corrosion, etc.
- Operate the system to make sure that the drive unit functions properly, and that the carriages all traverse the rails properly.

5.2 ADJUSTMENTS

5.2.1 CABLE TENSION

Before operating the system check the cable tension. There should be at least one inch of clearance between the nuts on the bolt that protrudes from the back of the winch mounting plate and the plate. If there is not, lower the carriages about 4 feet. Raise the carriages back up about one foot. Then adjust the manual tensioning sheave so that there is about 2 1/2 inches of clearance between the nuts on the bolt that protrudes from the back of the winch plate and the plate.



TOWER SYSTEMS, INC.

SCALE: NONE	APPROVED BY:	DRAWN BY ALS
DATE: 15 JUN. '77		REVISED

DRIVE CABLE ROUTING, T.I.E.S.

DRAWING NUMBER A10131